

Development Of FIAT-Based Parametric Thermal Protection System Mass Estimating Relationships For NASA's Multi-Mission Earth Entry Concept

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Part of NASA's In-Space Propulsion Technology (ISPT) program is the development of the tradespace to support the design of a family of multi-mission Earth Entry Vehicles (MMEEV) to meet a wide range of mission requirements. An integrated tool called the "Multi Mission System Analysis for Planetary Entry Descent and Landing" or M-SAPE tool is being developed as part of Entry Vehicle Technology project under In-Space Technology program. The analysis and design of an Earth Entry Vehicle (EEV) is multidisciplinary in nature, requiring the application many disciplines. Part of M-SAPE's application required the development of parametric mass estimating relationships (MERs) to determine the vehicle's required Thermal Protection System (TPS) for safe Earth entry. For this analysis, the heat shield was assumed to be made of a constant thickness TPS. This resulting MERs will then be used to determine the pre-flight mass of the TPS.

Two MERs have been developed for the vehicle forebody. One MER was developed for PICA and the other consisting of Carbon Phenolic atop an Advanced Carbon-Carbon composition. For the the backshell, MERs have been developed for SIRCA, Acusil II, and LI-900. How these MERs were developed, the resulting equations, model limitations, and model accuracy are discussed in this poster.

Table 1. Flight trajectory space considered for the MERs

Flight Trajectory Parameter	Range of Values	Resolution
Entry Velocity [km/s]	10-16	1
Entry Flight Path Angle [abs. deg.]	5-25	5
Ballistic Coefficient [kg/m ²]	41.95 – 128.74	15.5 (max)
Total number of trajectories	840	-

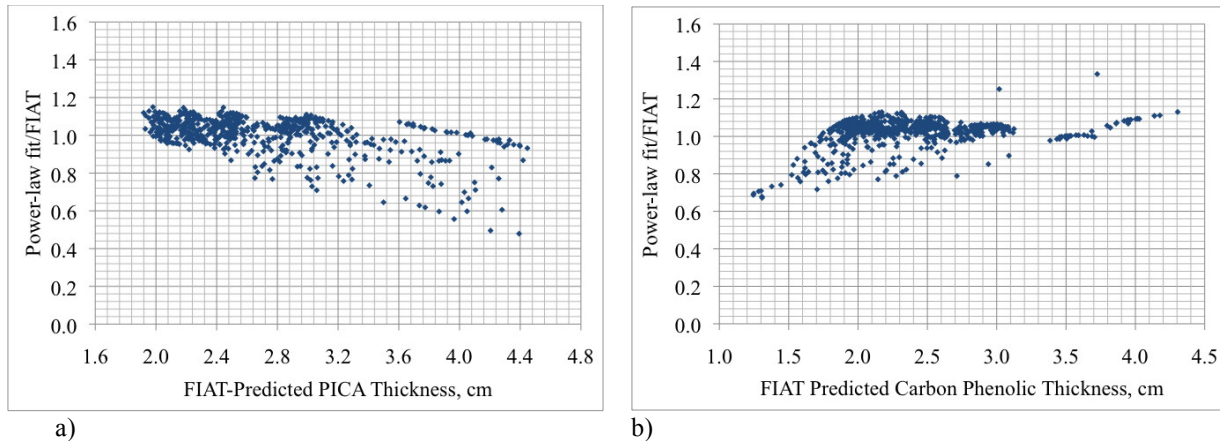


Figure 1. Goodness of fit for forebody MERs a) PICA and b) Carbon Phenolic atop Advanced Carbon-Carbon

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